**Electric field and forces, Electric field lines, Electric Dipoles, Charged particles in an electric field.**

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# Electric field and forces

# We look at the Followings

- Fields due to static and moving charges
- Lines of force and electric field lines
- Objects such as molecules, that are oppositely charged at two points or poles, DIPOLES
- Behavior of charged particles in an electric field

# Field

- A Physical Phenomenon such as a force, potential, that pervades a region. Examples are Electric field, gravitational field, magnetic field, etc.

# Charges and Dsitributions

- **Static Charges**
  - **Positive and Negative**

**Charge Distributions**

- ρ the volume charge density $\rho = dq/dV$ $C/m^3$
- σ the area charge density $\sigma = dq/dA$ $C/m^2$
- μ the linear charge density $\mu = dq/d/$ $C/m$

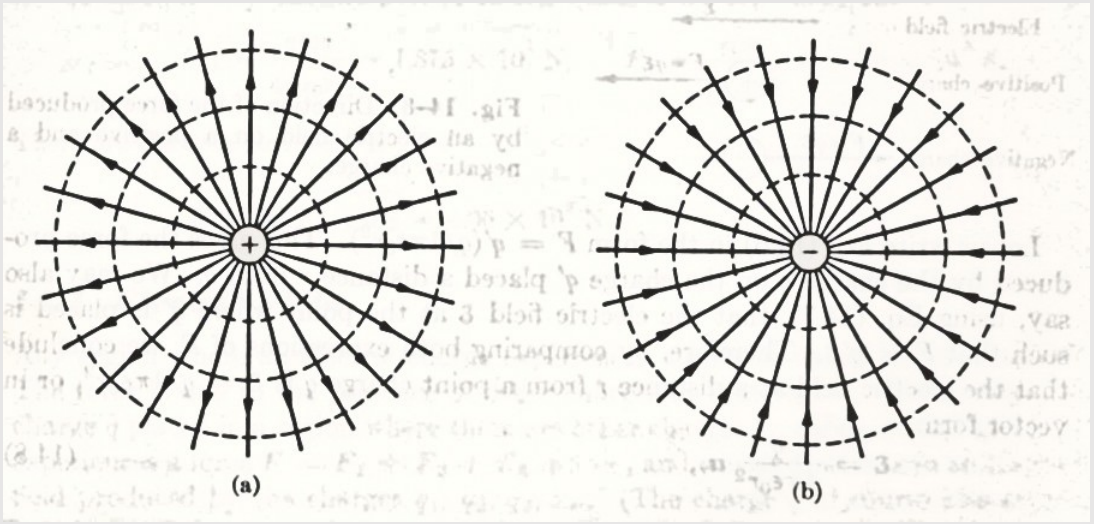
# Electric Field

- Any region where an electric charge experiences a force

- Vector
- Direction
- Magnitude

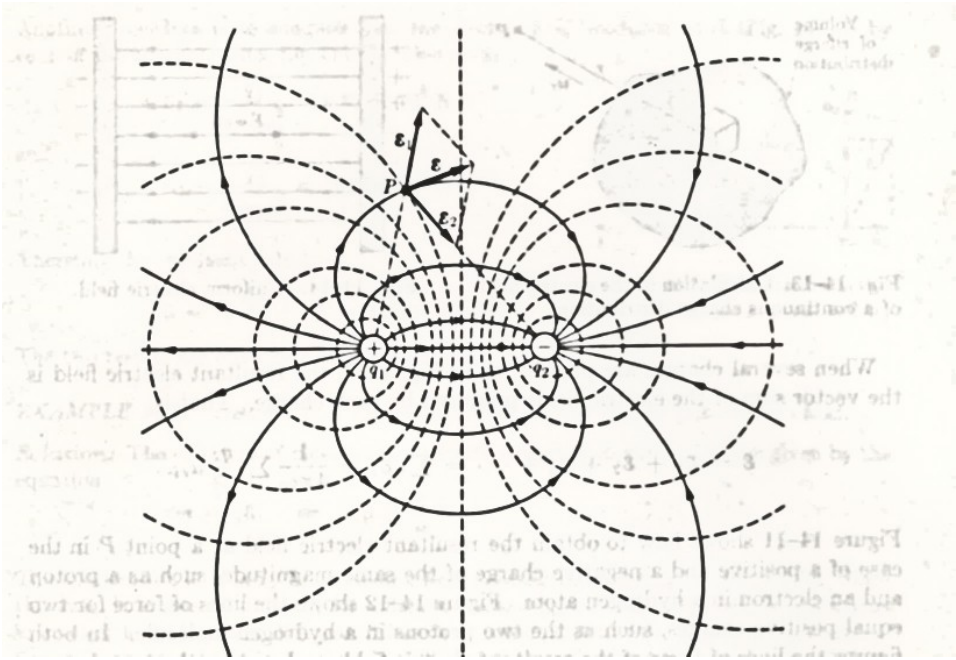
# Electric field lines

- Radially outward for +ve test charge
- Radially inward for –ve test charge
- Direction is from +ve to -ve



# Field lines and Equipotential Surface

- Potential



# Characteristics of Electric field lines

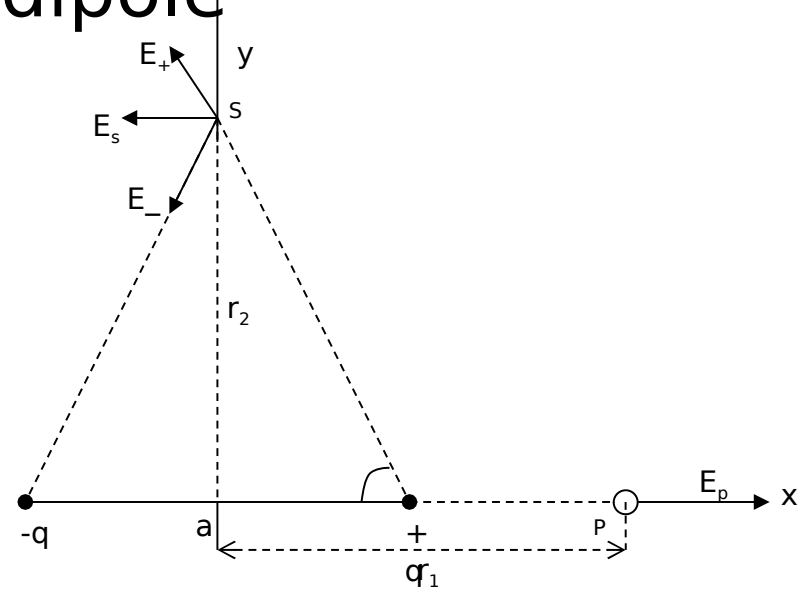
- Electric field lines radiate from the charges in 3 dimensions, hence an infinite number of lines could be drawn.
- They provide information about the strength of the field. Note that near the charges the field lines are close and the electric field strongest. As distances increase from the test charge the filed strength is weaker. *The number density (number of lines per unit area) passing perpendicular through an area is proportional to the magnitude of the electric field*
- Electric field lines are not always straight. Most often they are curved
- Electric field lines always begin on a positive charge and end on the negative charge

# Dipoles

- Two separate charges that have the same magnitude but opposite signs
- *Dipole moment, $p = qa$*
- Importance

# Dipoles

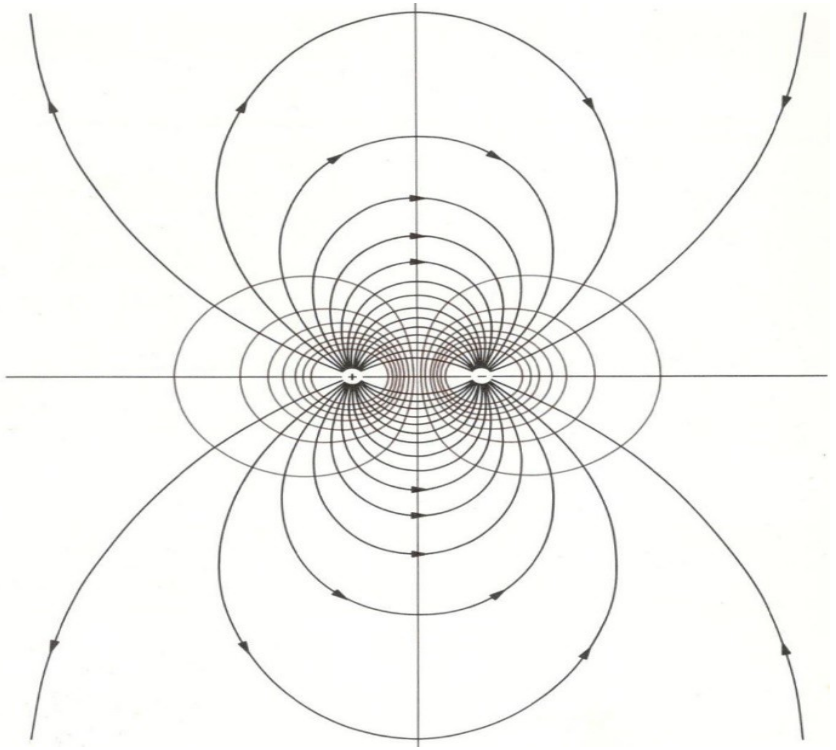
- Fields in a dipole



# Along the axis of the dipole

- by superposition principle
- Fields at far point
- Fields at near points
- the field of large charges close together is the same as the field of small charges at large distances as the field depends only on the product qa.
- a single isolated charge has its electric field fall as $1/r^2$, a dipole with two charges has its field falls as $1/r^3$

# Field lines of the Dipole, field and equipotential lines

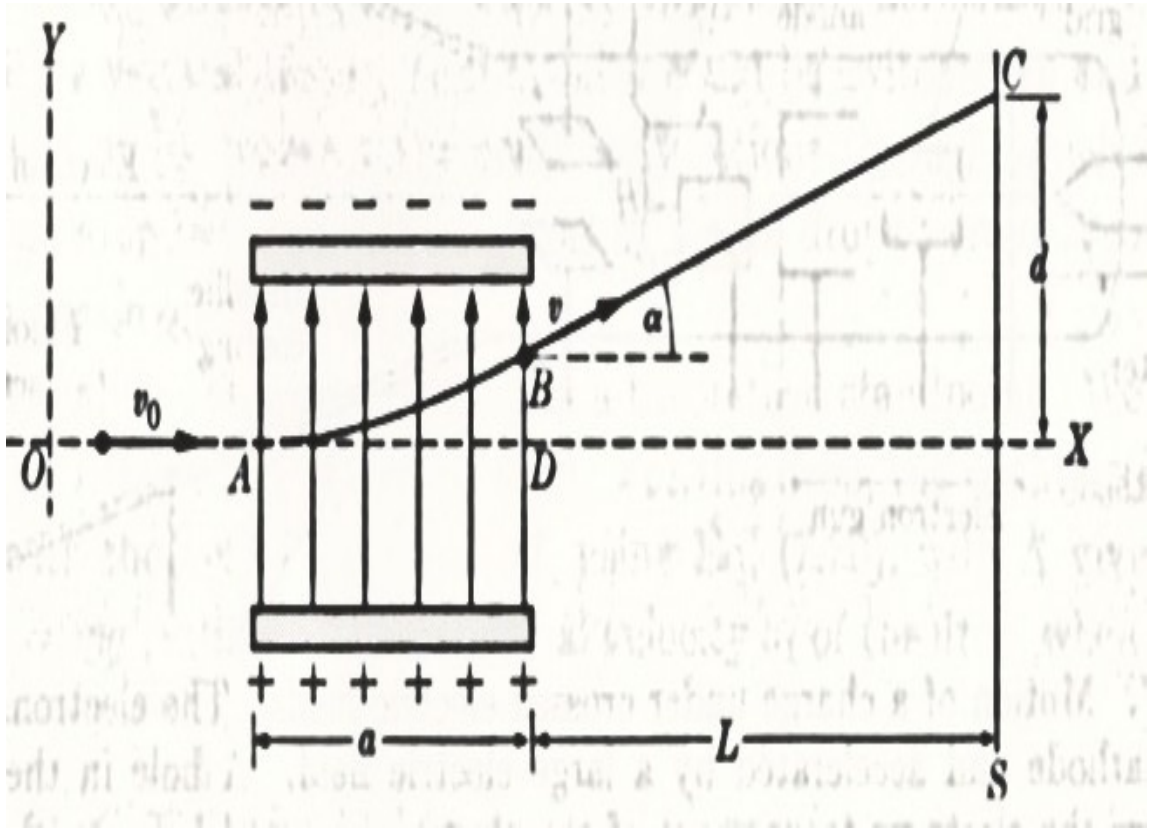


# Motion of Charged Particle in *E* field

- A charged particle in an electric field experience a force which causes it to move in the field. The equation of motion in the electric field is given by

- Motion in Electric and Gravitational fields

# Motion in an E field

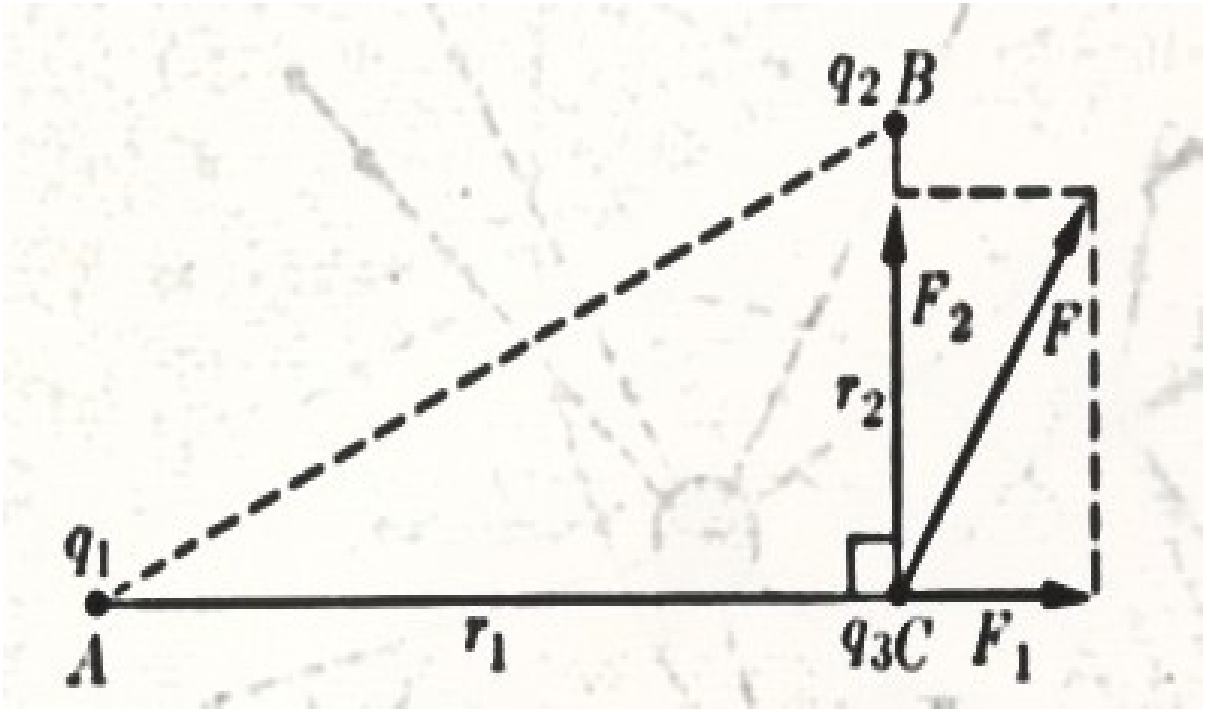


# Equation of Parabola

- Newton’s laws ***(x =ut +1/2 at²)***

# Example

- Given that Calculate the electric field, E produced by charges $q_1$ and $q_2$ at C.



# Two Approaches

- Through Coulomb's law
- Calculate E for each charges effects

# Coulomb

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Calculate $E_1$ and $E_2$ due to $q_1$ and $q_2$ on $q_3$, and find the resultant

# Angle or direction of the field

- or

# Assignment

- Due 2 weeks from this date